Lessons from the Habitat Suitability Models to evaluate the environmental variability of *Pinus nigra* Arnold. and *Pinus sylvestris* L. in the Iberian Peninsula.

Moreno, Elena[1]; G. Mateo, Rubén[2]; Rubiales, Juan Manuel[1]; Alberdi, Iciar[3]; García-Amorena, Ignacio[1].

[1]Universidad Politécnica de Madrid, Escuela Superior de Ingenieros de Montes, Departamento de Silvopascicultura, Spain.

[2]Universidad de Castilla-La Mancha, Spain.

[3] Instituto Nacional de Investigación Agraria, Centro de Investigación Forestal, Departamento de Sistemas y Recursos Forestales, Spain.

Contact: elena.moreno@upm.es

1. Introduction

☞ PREDICT POTENTIAL DISTRIBUTION → spatial and temporal evolution of the species under different climate scenarios → generation of habitat suitability models (HSM) → high degree of uncertainty and limitations.

☞ The importance of their validation has been stressed.

☞ In this work we discuss the present potential distribution of *P. sylvestris* and *P. nigra* in the Iberian Peninsula by using MaxEnt, and evaluate the influence of the different environmental variables.

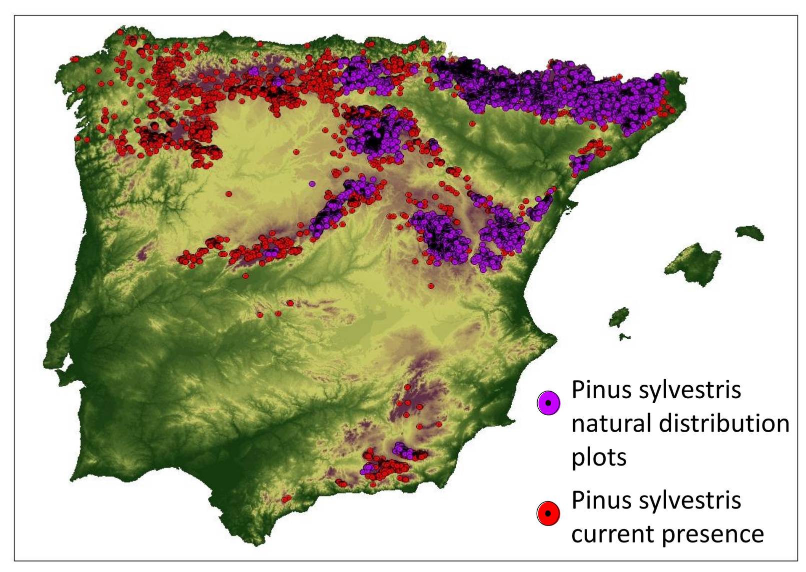
☞ **Our intention is to select a set of environmental variables that explains better their current distribution, to achieve the most accurate and reliable models. Then we project them to the past climatic conditions (21 to 0 kyrs BP), to evaluate the outputs with existing palaeo-ecological data.**

2. Data

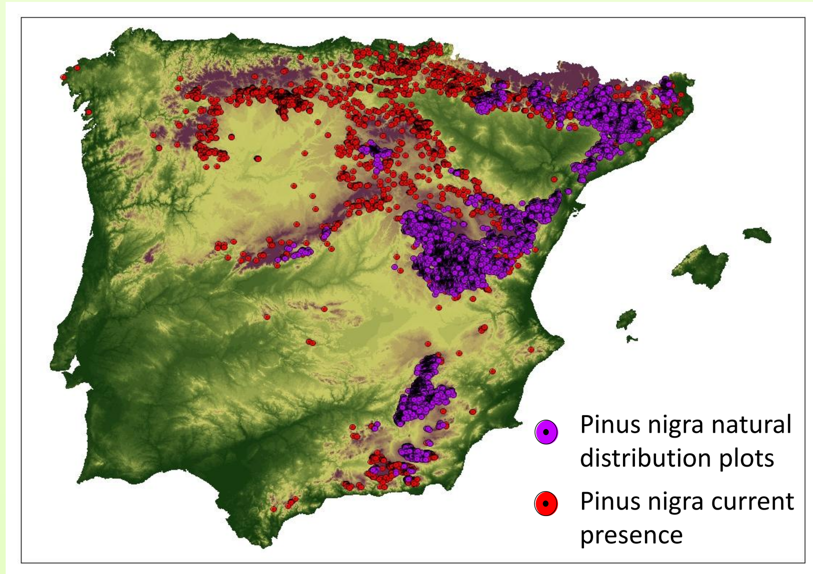
Input data:

***P. nigra* & *P. sylvestris* presence data:**

Third Spanish Forest Inventory (1 km grid) → using (1) current presence and (2) natural distribution deduced from *regions of origin maps*

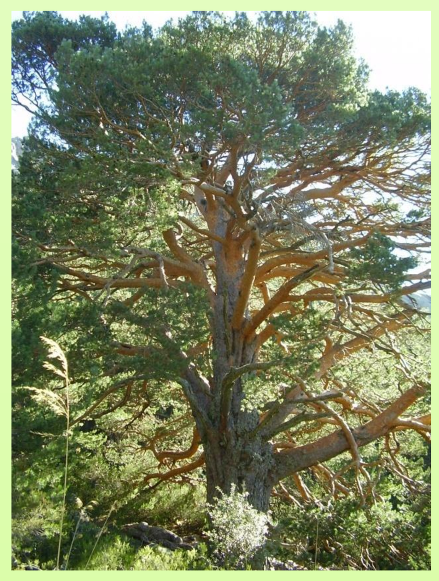


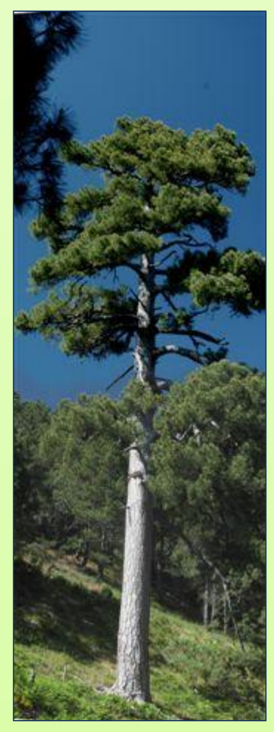
Pinus sylvestris



Pinus nigra

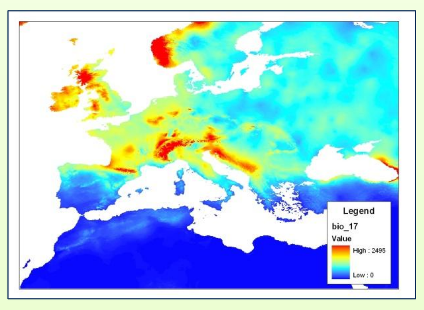
Species	Nº presence records (90% training / 10% test data)	
	Natural distribution	Current presence
P nigra	9,276	12,171
P sylvestris	11,868	15,363



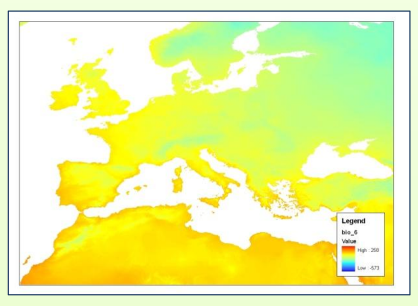


3. Environmental variables and models: dealing with the data

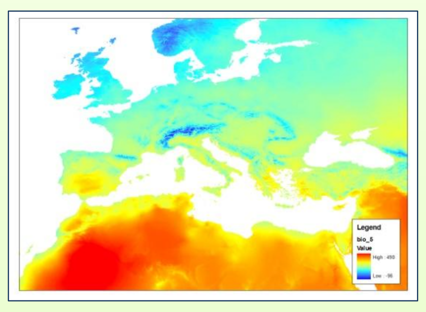
Climate data→ Worldclim database and the Spanish Phytoclimatic Atlas (Gonzalo, 2010).



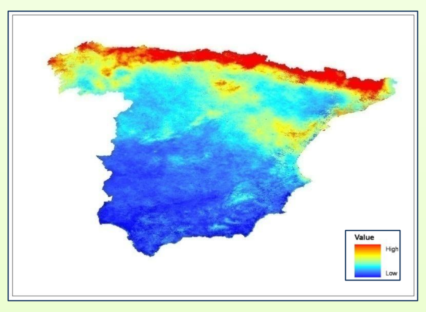
BIO 17: Precipitation Driest Quarter



BIO 6: Minimum Tª Coldest Month



BIO 5: Maximum Tª Warmest Month



PmTmax: Precipitation of the warmest Month

Models → Maxent → Method for modelling habitat suitability of species as a function of various ecologically-meaningful environmental predictors with presence-only data (Philips et al., 2006).

Selection of the variables:

☞What environmental variables had the most influence as predictors in the model?

☞Firstly, we run different models → evaluate how each environmental variable contributes to the model performance.

☞We select the most meaningful vbles. for each model (Fig 1) → avoid correlated variables

4. Tests and results

☞Natural ocurrences produced best performances on the HSMs.

WORLDCLIM DATABASE: bio 1 to bio 19 are used

Hypothesis → the most limiting environmental variables for these species:
bio5 (Warmest Month Max Temp), bio6 (Coldest Month Min Temp) & bio17 (Summer Precip).

☞Models show that bio17 does not have a major influence.

☞Bio4 (T Seasonality) → highest gain when used in isolation and appears to have the most meaningful information by itself and has information that is not present in other variables.

☞Models show Bio15 (Precip Seasonality) as the more influential precipitation variable.

❑***Pinus sylvestris***: the most influential variables are: **bio3** (Isothermality), **bio4** (Temp Seasonality), **bio9** (Mean T of Driest Quarter), **bio11** (Mean T of Coldest Quarter) and **bio15** (Precip Seasonality).

❑***Pinus nigra***: the most influential variables are: **bio3** (Isothermality), **bio4** (T Seasonality), **bio6** (Min T of Coldest Month), **bio9** (Mean T of Driest Quarter) and **bio15** (Precipitation Seasonality).

SPANISH PHYTOCLIMATIC ATLAS:

❑***Pinus sylvestris***: the most influential variables are: **tmf** (lowest monthly average temperature), **pe** (summer minimum monthly precipitation) and **pmtmax** (Precipitation of the warmest month).

❑***Pinus nigra***: the most influential variables are: **tmf** (lowest monthly average T), **p** (Annual precipitation) and **pmtmax** (Precipitation of the warmest month).

The resulting models obtained with the Spanish Phytoclimatic Atlas predict a smaller distribution and linked to mountain areas. Instead the distributions predicted by the WorldClim database reflect a more general extension.

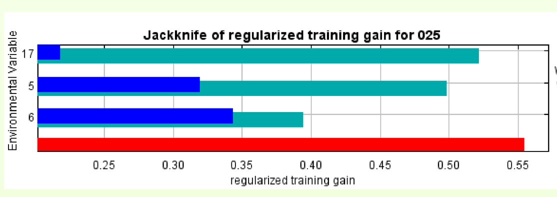
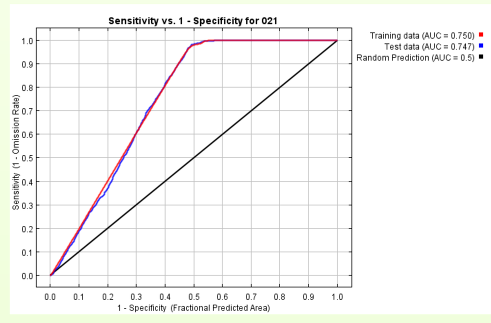
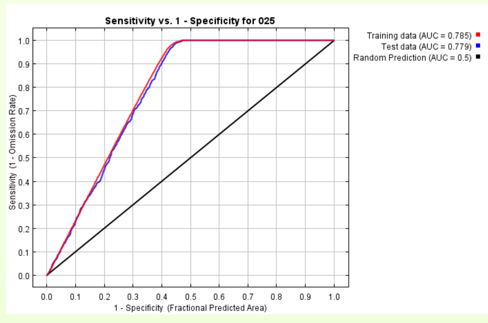


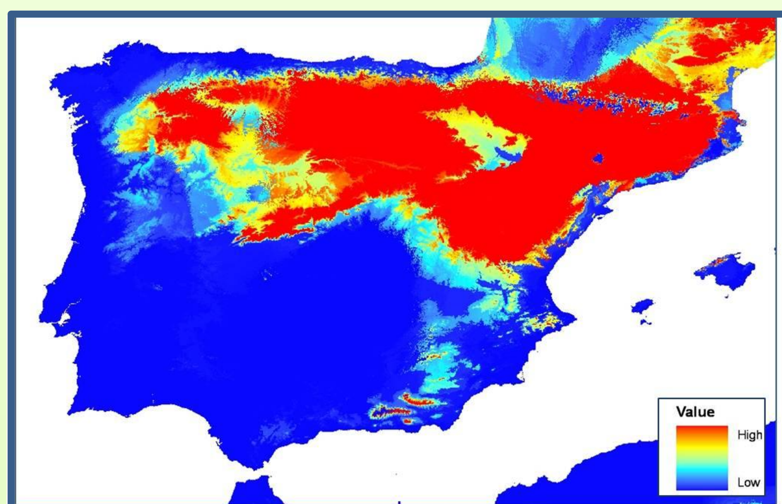
Fig 1.Jackknife of regularized training gain for *Pinus nigra*



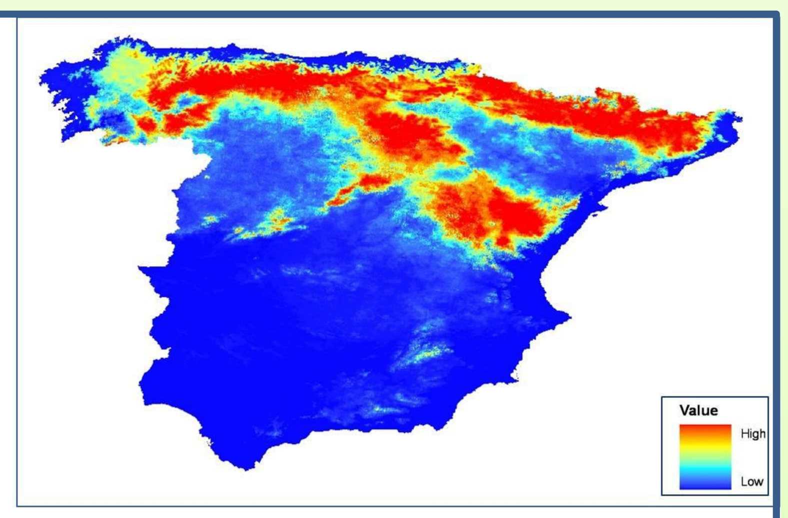
The area under the ROC curve (AUC) for *P. sylvestris*



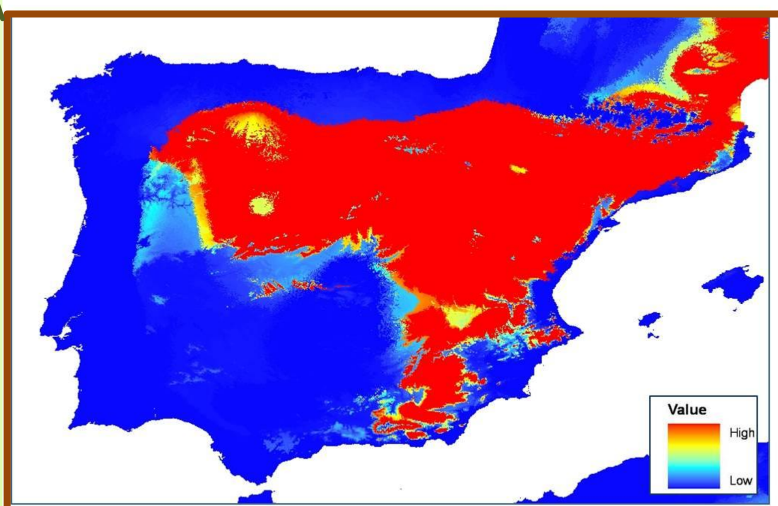
The area under the ROC curve (AUC) for *P. nigra*



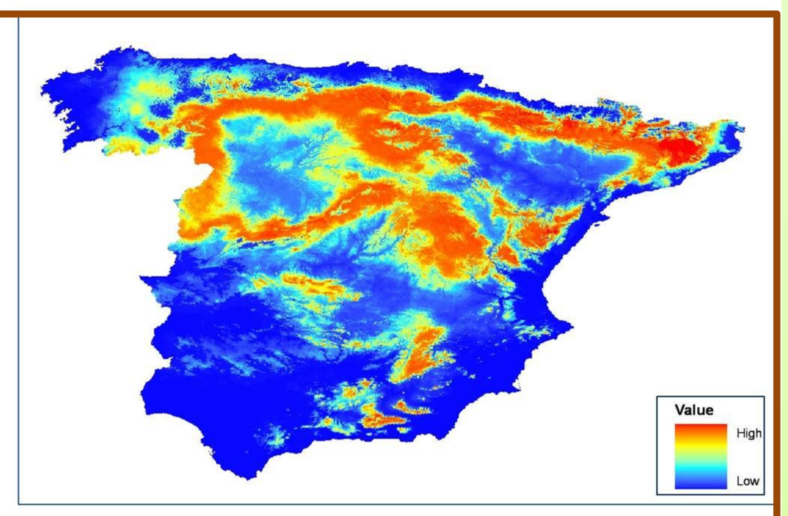
Maxent prediction of *P. sylvestris* present distribution with the Worldclim database



Maxent prediction of *P. sylvestris* present distribution with the Spanish Fitoclimatic Atlas



Maxent prediction of *P. nigra* present distribution with the Worldclim database



Maxent prediction of *P. nigra* present distribution with the Spanish Fitoclimatic Atlas

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References: Gonzalo, J. 2010. Diagnosis fitoclimática de la España peninsular. Organismo Autónomo Parques Nacionales.